Claims

The claims are amended as follows:

1. (Currently Amended) An open-loop pitch estimation device of a speech CODEC which estimates a pitch of an input speech signal, the device comprising:

an autocorrelation function calculation unit which calculates a normalized autocorrelation function from a perceptual weighing filtered speech signal;

a maximum autocorrelation function and a lag estimation unit which receives the autocorrelation function and estimates a maximum autocorrelation function, a lag having the maximum autocorrelation function, candidates for the maximum autocorrelation function and lags corresponding to the candidates for the maximum autocorrelation function;

a pitch candidate decision unit which decides a candidate for a pitch by using the ratio of the estimated maximum autocorrelation function to the candidates for the estimated maximum autocorrelation function, and the ratio of the lags having the estimated maximum autocorrelation function to the lags corresponding to the candidates for the estimated maximum autocorrelation function, and a lag smaller than a predetermined threshold as the candidate for a pitch; and

a pitch estimation unit which estimates a pitch between the candidate for a pitch and the lag corresponding to the estimated maximum autocorrelation function by using a pitch of a previous frame of the speech signal.

2. (Original) The device of claim 1, wherein the maximum autocorrelation function and lag estimation unit estimates the maximum autocorrelation function among the normalized autocorrelation functions and determines maximum autocorrelation functions prior to the estimated maximum autocorrelation function as the candidate for the maximum autocorrelation function.

3. (Currently Amended) The device of claim 1, wherein the pitch estimation unit calculates $K(d_x)$ for the candidates for the estimated maximum autocorrelation function by a formula $K(d_x) = a\,K_{log}(d_x) + (1-a)\,K_{corr}(d_x)$, $x = 1, 2, 3, \ldots, l$ and estimates a lag that is nearest to the pitch of the previous frame between a lag having $K(d_x)$ that is smaller than ~~a~~ the predetermined threshold and the lag having the maximum autocorrelation function,

wherein a denotes a predetermined weight, $K_{log}(d_x)$ is calculated by a formula $K_{log}(d_x) = \left| [d_{max}/d_x + 0.5] - d_{max}/d_x \right|$, l denotes the number of the candidate for the maximum autocorrelation function prior to the estimated maximum autocorrelation function, d_x denotes a lag of the candidate for the maximum autocorrelation function, and $K_{corr}(d_x)$ is calculated by a formula $K_{corr}(d_x) = \left| 1 - R(d_{max})/R(d_x) \right|$.

4. (Currently Amended) A method of estimating a pitch in an open-loop pitch estimation unit of a speech CODEC which estimates a pitch of an input speech signal, the method comprising:

(a) calculating a normalized autocorrelation function from a perceptual weighing filtered speech signal;

(b) estimating a maximum autocorrelation function, a lag having the maximum autocorrelation function, candidates for the maximum autocorrelation function and lags corresponding to the candidates for the maximum autocorrelation function;

(c) deciding a candidate for a pitch by using the ratio of the estimated maximum autocorrelation function to the candidates for the estimated maximum autocorrelation function and the ratio of the lags having the estimated maximum autocorrelation function to the lags corresponding to the candidates for the estimated maximum autocorrelation function, and a lag smaller than a predetermined threshold as the candidate for a pitch; and

(d) receiving a pitch of a previous frame of the input speech signal and estimating a pitch between the candidate for a pitch and the lag having the estimated maximum autocorrelation function.

5. (Original) The method of claim 4, wherein step (b) is characterized by determining the greatest one of the normalized autocorrelation functions as the estimated maximum autocorrelation function and determining the maximum autocorrelation functions prior to the estimated maximum autocorrelation function as the candidates for the estimated maximum autocorrelation function.

6. (Currently Amended) The method of claim 5, wherein step (c) is characterized by calculating $K(d_x)$ for the candidates for the estimated maximum autocorrelation function by a

formula $K(d_x) = a\ K_{log}(d_x) + (1\text{-}a)\ K_{corr}(d_x)$, $x=1, 2, 3, \ldots, l$ and determining the lag that is smaller ~~a~~ the predetermined threshold between the lags dmax and K(dx) as the candidate for a pitch,

wherein a denotes a predetermined weight, $K_{log}(d_x)$ is calculated by a formula $K_{log}(d_x) = \left| [d_{max}/d_x + 0.5] - d_{max}/d_x \right|$, l denotes the number of candidates for the maximum autocorrelation function prior to the estimated maximum autocorrelation function, d_x denotes a lag of the candidate for the maximum autocorrelation function, and $K_{corr}(d_x)$ is calculated by a formula $K_{corr}(d_x) = \left| 1 - R(d_{max})/R(d_x) \right|$.

7. (Original) The method of claim 5, wherein step (d) is characterized by estimating a lag that is nearest to the pitch of the previous frame among candidates for a pitch by using the pitch of the previous frame.

8. (Currently Amended) A ~~computer readable medium~~ machine readable storage medium which has ~~a computer program~~ instructions stored therein, which when executed cause a machine to perform a set of operations for running the method of claim ~~4 from a computer~~.